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Time to look for evidence: results-based approach to biodiversity conservation on farmland in Europe

Herzon I[1], Birge, T[1], Allen B[2], Povellato A[3], Vanni F[3], Hart K[2], Radley G[4], Tucker G[2], Keenleyside C[2], Oppermann R[5], Underwood E[2], Poux X[6], Beaufoy G[7], Pražan J[8]

[1]Department of Agricultural Sciences, P.O. Box 27, FI-00014 University of Helsinki, Finland

*Corresponding author

[2]Institute for European Environmental Policy (IEEP), 11 Belgrave Road, IEEP Offices, Floor 3, London SW1 V 1RB, United Kingdom

[3]Council for Agricultural Research and Economics, Centre for Policy and Bioeconomy (CREA-PB), c/o Palazzo Veneto Agricoltura, Via dell'Università 14, 35020 Legnaro (PD), Italy

[4]Independent environmental consultant Plum Tree House, Greatford, Stamford PE9 4QA, United Kingdom

[5]Institut für Agrarökologie und Biodiversität (IFAB), Böcklinstr. 27, D-68163 Mannheim, Germany

[6]AScA, 8 rue Legouvé 75010 Paris, France

[7]The European Forum on Nature Conservation and Pastoralism (EFNCP), Hamsterley Vale - Derwentside 97, Durham, NE17 7BE, United Kingdom

[8]Institute of Agricultural Economics and Information Manesova 75 120 58 Praha 2 Czech Republic

Abstract

Increased use of annual payments to land managers for ecological outcomes indicates a growing interest in exploring the potential of this approach. In this viewpoint, we drew on the experiences of all schemes paying for biodiversity outcomes/results on agricultural land operating in the EU and EFTA countries with the aim of reviewing the decisive elements of the schemes' design and implementation as well as the challenges and opportunities of adopting a results-based approach. We analysed the characteristics of results-based schemes using evidence from peer-reviewed

literature, technical reports, scheme practitioners and experts in agri-environment-climate policy. We developed a typology of the schemes and explored critical issues influencing the feasibility and performance of results-based schemes. The evidence to date shows that there are at least 11 advantages to the results-based approach not found in management-based schemes with similar objectives, dealing with environmental efficiency, farmers' participation and development of local biodiversity-based projects. Although results-based approaches have specific challenges at every stage of design and implementation, for many of these the existing schemes provide potential solutions. There is also some apprehension about trying a results-based approach in Mediterranean, central and eastern EU Member States. We conclude that there is clear potential to expand the approach in the European Union for the Rural Development programming period for 2021–2028. Nevertheless, evidence is needed about the approach's efficiency in delivering conservation outcomes in the long term, its additionality, impact on the knowledge and attitudes of land managers and society at large, development of ways of rewarding the achievement of actual results, as well as its potential for stimulating innovative grassroots solutions.

1. Introduction

In the words of McIntyre et al. (1992), the 'struggle to maintain biodiversity is going to be won or lost in agricultural systems'. For terrestrial systems globally, agricultural expansion remains the most prominent threat, while in Europe, increased specialization and intensification, and abandonment of high nature value (HNV) farmland (Oppermann et al. 2012) threaten biodiversity on farmland (Stoate et al., 2009; Poláková et al. 2011). As a result, a particularly high proportion of semi-natural habitats, and associated species, that are dependent on HNV farming systems and are protected under the Habitats Directive have an unfavourable conservation status (EEA, 2015). Meaningful engagement of farmers remains the key to the fate of biodiversity in the long term (de Snoo et al. 2012).

In the European Union (EU), by far the largest source of funding for practical nature conservation is being delivered through the agri-environment-climate schemes (AES) implemented under the Common Agricultural Policy (CAP) (Poláková et al. 2011). A review of monitoring evidence suggests that most AES lead to biodiversity benefits, but the performance of some has been unsatisfactory (Batáry et al. 2015). The prescriptive nature of the AES, inflexible payment conditions, poor targeting, and a low priority put on actual results have been identified as some of

the key reasons for poor effectiveness (Burton and Paragahawewa, 2011; Batáry et al. 2015). New approaches to delivering biodiversity objectives on farmland that encourage farmers to actively engage with the goals of environmental management are needed alongside the existing ones. These include support to voluntary non-monetary activities (Santangeli et al. 2016) and making payments conditional on delivering ecological results (Zabel and Roe, 2009; Burton and Schwarz, 2013; Reed et al., 2014).

Making public or private payments conditional on the delivery of results, that is 'ecological goods and services', has been actively explored under the framework of payments for ecosystem services (Gerowitt et al., 2003). The possibilities for integrating the ecosystem services approach into AES have recently been emphasized, alongside discussion on the strengths and weaknesses of this type of approach (Meyer et al., 2016; Reed et al., 2014; Matzdorf and Meyer, 2014). The focus on outcomes that is implied in such payments makes the process of design and implementation reliant on adaptive management and the capacity of land managers for innovation. This, in turn, requires the development of multi-party governance systems and experiment-driven environmental policy (Hiedanpää and Borgström, 2014). Refining policy tools and delivery requires a cultural change in the way that farmers engage with policy on the ground involving, inter alia, clearer goals and results orientation (Buckwell et al., 2017). In their review Burton and Schwarz (2013), made a first attempt of synthesizing evidence from the result-oriented schemes (12 at a time) and focused at the cultural and social change these may promote and require. The situation in the field progressed rapidly since then.

In this viewpoint we focus on the results-based payment (RBP) approach applied specifically to biodiversity on agricultural land across Europe, including extensive livestock systems (e.g. reindeer herding in forest-tundra areas of Lapland) and other HNV farmland (e.g. traditional orchards). We present a typology of the existing schemes that remunerate land-managers, mostly farmers, for biodiversity outcomes in the EU and European Free Trade Association countries (Norway and Switzerland), explore critical issues influencing the feasibility of the approach in the design and implementation stages, and discuss the opportunities and challenges of the approach. The viewpoint largely draws on work commissioned by the European Commission to review the advantages and challenges of adopting the RBP approach for the protection and enhancement of biodiversity (for full report see Allen et al. 2014).

As part of the study, we analysed the characteristics of all RBP schemes operating in Europe (within and outside AES agreements) and 20 responses from questionnaires distributed to key

practitioners involved in the design and implementation of these RBP schemes in 17 countries. Discussions with over 50 key experts in the field of agri-environment-climate policy and ecological indicators also aided the interpretation of the above evidence. Drawing from insights in the literature on participatory and experimental policy and on payments for ecosystem services, we discuss some of the opportunities and challenges of the RBP approach and suggest ideas for essential future research and policy development.

2. Implementation of payment-by-results approach in Europe

Though a multitude of schemes that involve payments for ecological services exist worldwide, there is no single agreed definition of what constitutes a 'results-based payment scheme' for biodiversity (other terms used are 'payment by results', 'outcome focused', 'performance payment', see Burton and Schwarz, 2013). We reviewed all schemes that, to varying degrees, financially reward or remunerate land managers for delivering verifiable biodiversity achievements on agricultural land. There is a range of approaches to delivering biodiversity objectives, from conventional management-based approaches to those that reward only the results irrespective of the management used. Despite the diversity of solutions, a pattern emerged relating to the extent to which the schemes' 'payment' and 'control' mechanisms are dependent on *a priori* specified biodiversity outcomes. Based on this pattern, we constructed a typology of the schemes (Table 1). At the time of the survey, there were only five schemes in Europe that paid according to the specified biodiversity results, prescribed no management interventions and allowed recipients of payments the complete flexibility to decide on management (*i.e.* pure results-based schemes, also Supplement Table A.1). Most of the RBP schemes were of the 'hybrid' type, in which certain management conditions were applied even if the payments were wholly dependent on results. We further discovered that the scheme type determines to a large extent specific implementation challenges and possible solutions.

#Table 1 here#

The first experiments with the RBP approach were carried out in the early 1990s using regional or national funding (Figure 1; Supplement Table A.1), and new schemes were introduced steadily in the following decades (Figure 1). Various national, regional, and provincial government sources, national park funds and private funding were used in the piloting stages, after which many of the

schemes were integrated into CAP-funded agri-environment programmes (or the equivalent in Switzerland). These additional funding sources are still used in several cases. The majority of RBP schemes operate in Northern and Western European countries. Many schemes have been established as trials for specific localities. These focus on specific biodiversity objectives within the defined areas and, hence, the implementation scales remain relatively small in terms of area covered and number of farmers involved. Additionally, there are well-established schemes covering thousands of hectares and involving thousands of payment recipients (e.g., Suvantola, 2013; Zabel and Holm-Müller, 2008; Fleury et al., 2015; Russi et al. 2016). Several pilot projects or schemes have been discontinued or superseded by new approaches (for example, in The Netherlands, trial payments to farmers per clutch of meadow birds by Meadow Bird Agreements scheme for farmer collectives; Table A.1). In addition, a suite of new pilots is currently underway (Supplement Table A.1) in four countries.

Concurrently with the increase in the number of RBP schemes, there is a growing body of peer-reviewed publications from research focused on the schemes (Figure 1). About half of them come from Germany, which has the highest number of federal government schemes and the longest experience with the approach. Most studies focus exclusively on the development and testing of ecological indicators and the schemes' performance in delivering ecological outcomes (e.g. Wittig et al., 2006; Bertke et al., 2008; Matzdorf et al. 2008; Höft et al. 2010; Kaiser et al, 2010). A handful of studies focus on the attitudes of recipients of payments to the new approach (e.g. Zabel and Holm-Müller, 2008; Schroeder et al. 2013), or on its economics (e.g. Hasund, 2013). In two countries research integrated ecological, social and economic assessments (e.g. Johst et al. 2002; Klimek et al. 2008; Haaren and Bathke, 2008; Magda et al. 2015; Russi et al., 2016). Valuable insights have been obtained from a re-assessment of the schemes' results and processes after decades of their implementation (Fleury et al., 2015; Russi et al., 2016).

#Figure 1#

The most common objective of the existing RBP schemes in Europe is the maintenance of semi-natural grassland communities. There are also RBP schemes for traditional orchards and vineyards, as well as for animal species of EU and national conservation interest (e.g. protection of breeding birds from farming operations, and for threatened raptors and carnivores) (Supplement Table A.1).

Numerous schemes offer headage payments for endangered native breeds of livestock, and area-based payments for endangered native crop varieties. While such schemes are results-based in their design, they represent a distinct category of payment that we do not consider here. These and payments for the number of trees in traditional orchards in most German federal states are excluded from Figure 1.

3. Ensuring effective design of results-based schemes

Most of the issues that are critical to the design of a successful RBP are common to all schemes promoting environmental land management (Moxey and White, 2014). Among these are the skills and capacity of the authorities, administrative costs, the quality of the IT support systems, and attitudinal factors (e.g. Prager and Posthumus, 2010; Young et al., 2013). Differences lie in the particular skills and attitudes that are needed. Three issues appear to be particularly critical to the success of schemes that pay for results. These are: i) clearly defined environmental objectives, ii) suitable indicators of these objectives, on which the result payments are based, and iii) socio-economic context.

The appropriateness of an RBP scheme will depend firstly on the definition of clear biodiversity objectives based on the most accurate and up-to-date data. Existing schemes mainly target the maintenance of threatened habitats (e.g. species-rich meadows) and species (e.g. Golden Eagle *Aquila chrysaetos*) rather than common farmland biodiversity (Supplement Table A.1) since their ecological requirements are well understood, as are the impacts on them of agricultural management. In general, RBP schemes are better suited to maintaining existing habitats that are in good ecological condition (where the farmers can draw on their experience in managing the habitat) rather than the restoration or re-creation of habitats (where conservation measures unfamiliar to the farmer may be required).

Secondly, there is a consensus that the existence of reliable indicators of the specified biodiversity objective is the most important practical consideration, since presence of the indicators is the basis for verification to release the payment. Burton and Schwarz (2013) argue that the success or failure of schemes in delivering their ecological results largely rests on the quality of the result indicators. In addition to the general criteria for a biodiversity indicator (e.g. Feest, 2013), the results indicators in RBP schemes on farmland should: i) not be easily achievable by means other than agricultural management, ii) be understandable and linked clearly to biodiversity objectives that are acceptable

to land managers and paying agency representatives (i.e. not seen as 'bad farming'), and iii) be easily measurable following initial training (reviewed in Allen et al. (2014)). Designing an RBP scheme is justified only if potentially suitable biodiversity result indicators can be identified, which may not be possible for all biodiversity objectives or locations.

Thirdly, specific socio-economic factors need to be taken into account. These include stakeholder attitudes to innovation and risk taking, the existence of a culture of trust between the different actors, and accountability levels. Other important socio-economic factors, such as the capacity of the authorities and compatibility with other national policy regulations, are common to any payment scheme. Meyer et al. (2016) demonstrated that successful AES based on ecosystem service delivery require, above all, local-scale knowledge about economic, social, and ecological circumstances.

#Box 1 here#

We identified the essential steps for each stage of the life cycle of RBP approach (Box 1). At every stage, the approach has specific challenges for design and implementation and for many of these, the existing schemes provide potential solutions. Several questionnaire respondents in Greece, Estonia, Finland, Latvia, Slovakia and the UK perceived the RBP approach to be incompatible with the EU and/or WTO rules on calculating payments and their subsequent control and verification. This is contrary to the evidence (Hasund and Johansson, 2016; Russi et al., 2016): the payment level in most RBS schemes, like that of many management-based schemes, is determined in accordance with WTO rules. This means that the payment rate is calculated on the opportunity costs of the management that is considered most likely to be required to achieve the results, and not on a valuation of the results as such. RBP schemes are frequently built upon or complement existing AES and use the existing administrative infrastructure.

'Tuning' the scheme is best achieved during its piloting or over several years of scheme implementation (e.g. the process of gradual development of MEKA scheme in Germany in Russi et al., 2016; or the scheme for birds breeding in meadows in The Netherlands in Allen et al., 2014, p. 55, also Verhulst et al., 2007), which is true for any novel method of policy delivery (cf. Meyer et al., 2016; Radley, 2005). Options for indicators range from the numbers of a single species to a composite indicator with species numbers and habitat attributes (e.g. DAFF, 2016 in Ireland). The most important consideration is to ensure that the indicator thresholds do not reward the

deterioration of the most biodiverse sites. This can be prevented by having multiple indicator thresholds (as in Russi et al., 2016). In hybrid RBP schemes, the payments are dependent on some management prescriptions that aim to maintain baseline conditions. Hybrid schemes may also be required because not all biodiversity aims can be practically measured through indicators. However, just as with the management-based payments, the owners of the sites with the highest biodiversity may still not receive a sufficient incentive for maintaining exceptional biodiversity, if the threshold is determined by the average situation.

Setting an appropriate payment level so that it reflects the full cost of achieving the desired outcomes, including time spent on training and monitoring of ecological results by farmers, while also keeping the schemes simple and cost-effective is a challenge (Cooper et al., 2009) that can be resolved only through experimentation. The participation risk for newcomers to the scheme can be reduced by setting fairly easy entry conditions with an increasing demand for a higher target and higher payments later (Schroder et al., 2013). Ways of calculating payments vary from a single bonus payment for the results additional to the baseline payment for management to an iterative process of auctioning (see Allen et al., 2014 for the technical information). As with the management-based AES payments, sustaining the participation level requires that remuneration levels respond to the shifting opportunity costs of participating in the biodiversity scheme (Russi et al., 2016). Practice shows that some AES, regardless of their nature, are not widely implemented if the payment rates do not reflect the land managers' perceived costs, including time spent on the application process and controls.

Ideally, the process of verifying result indicators should be such that the land managers can understand and carry it out themselves. This is considered valuable regardless of whether the managers are required to conduct their own verification of achieved ecological results, because it allows assessment of one's performance and facilitates adaptive management (e.g. Fleury et al., 2015; Russi et al., 2016). Most farmers welcome a chance to learn more about the features they are managing regardless of the payment structure (Fleury et al., 2015; Birge et al., 2017). Although verification approaches vary among the schemes, the involvement of several interest groups – biologists, farmers or herders, agronomists, NGOs – in their development and testing is pinpointed as a basis for the scheme success (e.g., Fleury et al., 2015; Matzdorf et al., 2014). This can be facilitated by involving voluntary organisations (e.g., environmental and community groups), which can help fine-tune the scheme in line with principles of adaptive co-management as illustrated by landscape stewardship initiatives in Europe (García-Martín et al., 2016).

Attracting wider public attention to the innovative RBP schemes was an important part of implementation in France and served as an additional reward instrument (Fleury et al., 2015). Though it may not essential for the scheme's instigation, it may render long-term support in running and enlarging the scheme. Regardless of their other attributes, all the schemes that were reviewed demonstrated the need to keep things as simple as possible whilst achieving the desired biodiversity outcome and recognising the needs of all the key interest groups.

4. Opportunities and challenges

Most of the potential advantages of the RBP approach for both the farmer and for the managing authority compared to management-based schemes with similar objectives have been verified in the literature (Table 2) and by experts. The majority of the respondents confirmed that uptake of the RBP options has increased over time as land managers become more familiar with the new approach (see also Burton and Schwarz, 2013). Some even considered the element of risk associated with RBP schemes was mentioned as positive. Farmers can get a great sense of pride from overcoming adversity, while management-based payments may not be engaging (e.g. an interesting challenge) and are, instead, viewed as a bureaucratic nuisance (Sligo and Massey, 2007). Integration of socio-economic co-benefits may increase uptake and promote long-term attitudinal change (Burton and Paragahawewa, 2011): for example, in France, biodiversity aims are combined with agronomic ones, which reinforces the production role of the farmer and results in a collective learning process for all participants and increases public consensus on management objectives (Magda et al., 2015; Fleury et al., 2015).

#Table 2 here#

We also identified circumstances where a well-designed and targeted management-based approach is likely to be more appropriate than a RBP one for the same environmental objective. Such situations particularly arise when: i) it is impossible to develop reliable indicators and methods of measuring them within reasonable costs, ii) achieving a measurable outcome takes an unreasonable length of time and delays the payment to the land manager (high concern for farmers), iii) the managing authority has no access to the information and expertise needed to set up and run a RBP scheme (high concern for authorities); or iv) the farming community is unwilling to accept a RBP

approach. For example, there is a clear apprehension about initiating the RBP approach in Mediterranean, central and eastern EU Member States. The reasons mentioned were their recent predominant command-control culture and a lack of trust between the authorities and farmers (see also Prazan and Theesfelt, 2014). More clarity in the objectives behind the transactions between the state and farmer for the AES may be an important tool for building trust in the policy.

Devising an appropriate system for results verification has been cited as a critical difficulty in the adoption or extension of RBP schemes. While the high administrative costs of the RBP scheme in Ireland are regarded as a barrier to scaling up the scheme, Russi et al. (2016) provided evidence of low transaction costs and cost-efficient ways of verifying results in a long-running RBP scheme in Germany. Some costs of scheme establishment may be high in the early years and then decline (see also Schwarz et al., 2008). Competitive bidding for outcomes, as opposed to fixed-price payments, within the RBP approach may provide new opportunities in tackling over- and under-compensation for delivering the results (e.g. Klimek et al., 2008). However, in the set-up of tendering processes, a trade-off between the achievement of environmental outcomes and the budgetary costs usually leads the public agency to compromise solutions (Schilizzi and Latacz-Lohmann 2016).

It is not uncommon that management-based AES are designed to facilitate the reliable distribution of funds to farmers and to reduce running costs, with the major indicator of success being participation rates rather than actual environmental benefits (Keenleyside et al., 2011). This may be a “false economy” (Reed et al., 2014). Running costs may be lower, but there is a risk that the payments to farmers will not achieve any appreciable environmental benefit (Armsworth et al., 2012). Management based schemes may also have poor additionality: for example, continuing to provide payments to farmers even when the targeted outcome is no longer being achieved. Both approaches risk providing payments for outcomes that would have happened anyway with no added value to the existing situation (Russi et al. 2016). Unfortunately, little is known about the biodiversity cost-effectiveness of management-based AES, even if they have been running for decades.

In making payments dependent on the achievement of results, the RBP approach risks provoking disputes over whether or not those results have actually been achieved. A robust system of dispute resolution that is fair to both sides helps to increase farmers’ confidence in the RBP schemes. In Ireland, farmers are not only given training in the assessment that determines payment levels but also are encouraged to challenge the scores given by the independent assessors (J. Moran, IT Sligo, *pers. comm*.). However, the close involvement of farmers may lead to the manipulation of baselines

312 and thresholds on the land that may be enrolled in the scheme in ways that undermine
313 environmental additionality (Zabel and Roe, 2009; Burton and Schwarz, 2013).

314 A major challenge faced by the RBP approach is, thus, enhancing the collaboration and trust among
315 the parties, which would allow for fair and low-cost verification of the results, effective conflict
316 resolution mechanisms, and experimentation with management for optimal delivery of results.
317 Schemes that have been successful take full account of best practice in participatory policy
318 processes. Effective involvement of payment recipient groups throughout the scheme's life cycle is
319 essential for clear communication of the objectives as a precondition for payment, for risk
320 management and conflict resolution (e.g., Stringer et al., 2006; Young et al., 2013; Reed et al.,
321 2014). Bringing different types of knowledge together, framing situations for joint learning and
322 planning in a collective manner, and engaging civil society organisations are all essential elements
323 (Bruckmeier and Tovey, 2008; Meyer et al., 2016). Indeed, some of the RBP payments are made
324 available as collective rewards (e.g. Zabel and Holm-Müller, 2008; de Lijster and Prager, 2012;
325 Hiedanpää and Borgström, 2014). It is plausible that, in the future, the RBP approach will
326 contribute to such socio-economic co-benefits as building community cohesion and multi-party
327 networking around agricultural land-use.

328 Biodiversity outcomes are not the only area where the RBP approach could potentially be applied.
329 This is demonstrated by payment schemes worldwide for such outcomes as water quality, soil
330 protection, flood and fire resilience (Schomers and Matzdorf, 2013). For example, the AES aimed at
331 water quality in German federal states include a results-oriented requirement (keeping N surplus
332 below a specified level) (Techen and Osterburg, 2011; Wezel et al., 2016). A scheme in Spain aims
333 primarily at reducing the fire hazards associated with publicly owned forestland (Ruiz-Mirazo et al.,
334 2011). Each scheme targeted at an ecosystem service will have specific challenges of design and
335 implementation.

336

337 **5. Conclusions**

338 Given the range of situations in which RBP schemes are appropriate, there is clearly considerable
339 potential to expand the use of the approach within the AES for the next CAP Rural Development
340 programming period 2021–2028. Addition of a results-based scheme as an alternative to or
341 replacement for an existing management-based schemes aimed at the same biodiversity objective,
342 or adding a more demanding results-based top-up to existing management-based scheme

(contractually separate schemes) are relatively low-risk steps. However, when paying land managers for the 'ecological goods and services' they provide, limiting compensation to covering only the costs of production will remain a weak incentive, and does not reflect the risk involved. A true results-based approach should also reward the achievement of actual results, above the costs of their delivery, comparable to the profit margin of producing a market product (Reed et al., 2014). Practical solutions demonstrating how this principle can be implemented are still wanted.

A need to redefine the development path for EU farming past the 2020s by focusing CAP funding on delivering outcomes and maximising the cost-effectiveness of the policy has been identified by several authors (e.g. Mann, 2017). Any change in policy implementation carries a cost that can be recovered only with time. Examples from the existing schemes provide a variety of working solutions to many of the challenges of designing and implementing the RBP approach. These do, however, come from a limited number of countries. The recent support by the European Commission for piloting the RBP approach in four countries with contrasting socio-economic contexts and experience with the approach through targeted funding is well timed[1]. Equally important is intensification of research efforts on the aspects critical to the effectiveness of the approach. These are particularly: development of suitable indicators of the defined biodiversity objective, the additionality of the approach in the long-term delivery of biodiversity outcomes, cultural change, and, finally, cost efficiency and its change over time. Does the approach channel support to the conservation of the most important habitats and species and most important sites for them? Does it lead to enhancement of the existing biodiversity values over time compared to simply maintenance? Does it contribute to strengthening intrinsic motivations of participants? In what domains does the approach increase the awareness of farmers about the biodiversity on their land and their own role in its protection and production? And does this result in adaptive management and grassroots-level innovative solutions? Does it create links between farmers as providers of ecosystem services and the society as their consumer? How does cost efficiency develop with accumulated experience and widening implementation scales? How does cost efficiency of both results-based and management-based approaches for the *same* biodiversity objectives compare? Bridging sociological and ecological approaches will provide much needed monitoring of social co-benefits. Policy development for results-based approaches will also benefit from research into participatory modes and use of participatory modeling. In particular, focus on the process of social learning is necessary to orientate land managers and administration personnel alike toward results and experiment-driven environmental policy. The RBP schemes for biodiversity using the CAP and

375 other tools make an important case for developing payments for ecosystem services in the European
376 context.

377

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386 [1] See the website rbaps.eu for further information

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560 Table 1: Typology of the payment schemes for biodiversity on agricultural land in Europe. More specific information on all results-based
561 schemes by type and country of implementation is in Supplement Table A.1.

Scheme type	Category	Main characteristics	Basis for payment	Example schemes
Results-based payment schemes	Pure results-based	No management actions are either specified or required	Solely biodiversity results measured with indicators: single payment threshold, stepped payment thresholds or continuously variable payments	Species-rich grasslands in Brandenburg, Germany: single payment for at least four indicator plant species. Semi-natural grassland in Lower Saxony, Germany: payment for at least 4 indicator species and top-up payment for additional 2 species. Conservation performance payments in North Sweden: payments according to the numbers of wolverine and lynx offspring
	Hybrid: Results-based with baseline management requirements	Holders have to undertake some defined management actions (or abstain from certain activities) as a baseline requirement of a results-based contract	Single or stepped payment thresholds payment is wholly dependent on biodiversity results, measured using one or more environmental indicators; management actions have to be undertaken as an unpaid condition	Species-rich grasslands in Baden-Württemberg, Germany. Payment for at least 4 indicator plant species; additional management requirements (e.g. no early silage cuts).
	Hybrid: Management-based with an optional	Similar to the above but the contract is management-based and the results element is optional	Basic payment for management actions and an extra (top-up) payment if results are achieved	Pasturing contracts in Solothurn, Switzerland: basic payment for management requirements, in addition several steps for results based on judgement of species

	results-based top-up			richness, structural richness and difficulties of management.
Management-based schemes	Management-based schemes	Holders only have to undertake specified management actions or abstain from certain activities	Payments linked to management actions having the conservation of biodiversity as their primary purpose	Most of biodiversity schemes in AES programmes
	Farming system oriented schemes	Same as above	Payment linked to defined farming systems known or believed to produce biodiversity benefits.	Schemes that promote organic farming or seek to maintain High Nature Value Farming

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Box 1: Essential steps in the life cycle of the results-based payment scheme (after Allen et al., 2014).

I Exploration and feasibility assessment

1. Building sufficient scientific and expert knowledge of the influence of farming practices on species and ecosystems within the area of the proposed scheme.
2. Determining existence of biodiversity priorities, for which agricultural management is the key factor in ensuring the conservation of that biodiversity.
3. Checking compatibility of the RBP scheme with national policy regulations, especially for payments coming from the CAP.
4. Identifying potential sources of funding apart from the CAP.
5. Identification of the civil society actors in areas that have a potential to contribute with context-specific knowledge and skills.

II Design

6. Setting a well-defined environmental objective that is sufficiently clear for land managers to understand and attractive to support (e.g. not conserving a noxious weed).
7. Choosing and testing appropriate and reliable indicators of the defined environmental objective.
8. 'Tuning' the scheme so that indicator thresholds are set at the right level to maintain or improve conservation condition, to encourage participation but prevent deterioration of the most biodiverse sites.
9. Designing an effective payment structure that is tailored to the biodiversity objectives and indicator thresholds, their ecological importance and desired uptake, and in compliance with the EU and national rules.
10. Developing a system of verifying results (not management) and controlling results-based payments that meet the EU requirements, and training the paying agency's staff in its use.
11. Developing an effective IT system that supports the design and operation of the scheme rather than distorting or limiting it.
12. Developing a simple, objective, repeatable and unambiguous method of monitoring whether the biodiversity indicators as well as expected biodiversity results have been achieved.

III Implementation stage

13. Using an appropriate pilot to test out scheme design and operation, to give farmers practical experience of a results-based approach and to develop people with expertise in, and enthusiasm for, results-based schemes and who can train others and act as advocates for this approach.
14. Securing the positive engagement of land managers and other key stakeholders in scheme development, without diluting the environmental focus of the scheme.
15. Using the 'freedom to farm' that results-based schemes allow to build land managers' acceptance of, and interest in, environmental land management while providing guidance on management necessary to bring about the desired outcomes.
16. Providing high levels of facilitation, advice and support to applicants and contract holders.
17. Encouraging innovation, self-help and mutual learning, and finding positive ways of harnessing the power of peer group pressure.
18. Building up awareness about the scheme, also among the public.

III Evaluation and Review

19. Monitoring, evaluating, and refining the RBP scheme based on learning from its implementation with engagement from all stakeholders.

615 Table 2. The potential advantages of the results-based approach as compared to the conventional
616 management-based payment delivery based on literature and experts interviewed in the current
617 review.

Potential advantages	Specific references
Clearer link between payment and biodiversity achievement and thus the transaction between the state and farmer	Matzdorf and Lorenz, 2010; Zabel and Roe, 2009; Osbeck et al., 2013
Effective achievement of an environmental objective that depends on a complex set of farm practices	Matzdorf and Lorenz, 2010; Prince et al., 2012
Making the 'production' of biodiversity more an integral part of the farming system and farm business, not just another set of land management 'rules' to be followed	Matzdorf and Lorenz, 2010; Burton and Schwarz, 2013; Russi et al., 2016
Giving farmers the opportunity to use their management skills, professional judgement and knowledge of the farm	Haaren and Bathke 2008; Klimek et al., 2008; Osbeck et al., 2013
Providing payment recipients with management flexibility	De Sainte Marie, 2014; Matzdorf and Lorenz, 2010; Russi et al., 2016
Farmers/land managers being encouraged to take responsibility for and to 'own' the biodiversity results	Zabel and Holm-Müller, 2008; Magda et al., 2015
More easily meeting the strengthened EU requirements for verification of AES payments under the 2014-2020 CAP	Allen et al., 2014
Cutting 'deadweight' from schemes via a built-in incentive for farmers to select only the land where the biodiversity results are additional to the baseline	Burton and Schwarz, 2013; Birge et al., 2017
More straightforward verification and control	Matzdorf and Lorenz, 2010; Groth, 2009; Russi et al., 2016
Operationalising the learning component of adaptive management for all actors: increasing the awareness of land managers about the biodiversity on their land, and contributing	Magda et al., 2015; Fleury et al., 2015; Russi et al., 2016

to public recognition of farmers' role in supporting biodiversity; changing farmer attitudes towards conservation	
Creating or strengthening links among different actors	Haaren and Bathke 2008; Zabel et al., 2014; Magda et al., 2015; Fleury et al., 2015

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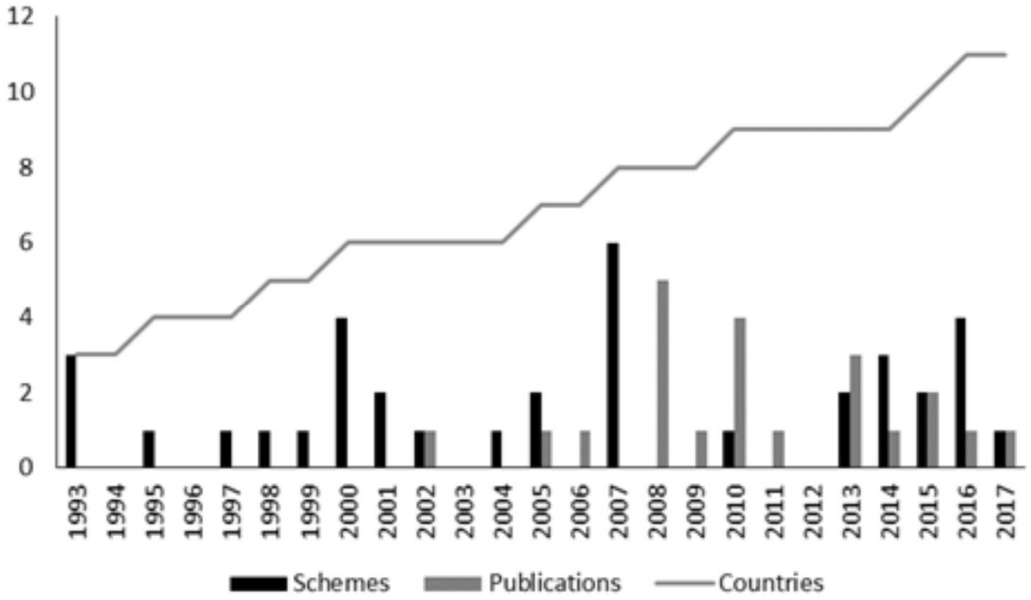
Figure legends

Figure 1. Results-based payment schemes for biodiversity on agricultural land in Europe, number of peer-reviewed publications that focus on specific results-based payment schemes (but not generally describing the results-based approach) and the cumulative number of countries of the EU, Norway and Switzerland with these schemes. The federal states in Germany are grouped together.



Appendix Table A.1. Existing and discontinued results-based payment schemes and their prototype assessments for biodiversity in agricultural environments in Europe, listed by country. Pure results-based and hybrid refer to the typology proposed here (Table 1). Description of most of the schemes' design can be found on the site Farming for Biodiversity: The results-based agri-environment-climate schemes (RBAPS- project) (last updated 10.06.2016) http://ec.europa.eu/environment/nature/rbaps/fiche/index_en.htm

Country, region	Starting year	Name and/or biodiversity objectives	Category	Additional information	Sources in English[1]
		Existing or discontinued schemes			
AT	2015	Ergebnisorientierter Naturschutzplan (ENP) Semi-natural grazed habitats	Pure results-based		RBAPS- project database Results-based nature conservation plan - Pilot project leaflet. Available at: http://static.suske.at.
FI Sami Reindeer area	1998	Golden Eagle scheme	Pure results-based	Collective payments	RBAPS- project database Hiedanpää and Borgström, 2014; Suvantola, 2013
FR	2007	Flowering Meadows Scheme (HERBE_07) Species-rich grasslands	Hybrid		RBAPS- project database Fleury et al., 2015; Magda et al., 2015; De Sainte Marie, 2014. RBAPS- site (includes a blog posting, video and conference presentation)
FR	2007	Pastoral management plan (HERBE_09) Semi-natural grazed habitats	Hybrid		RBAPS- project database
DE Steinburg, Schleswig-Holstein	2007	Blühendes Steinburg Species-rich grassland	Pure results-based	Privately funded	RBAPS- project database

DE Baden-Württemberg	2000	MEKA B4 Species-rich grassland	Hybrid	RBAPS- project database Matzdorf, B. & Lorenz, J. 2010; Russi et al., 2016.
DE Rheinland-Pfalz	2007	Kennarten programme (PAULa) (now EULL) Species-rich grassland	Hybrid	RBAPS- project database. RBAPS- site (includes a video).
DE, other federal states	2007	Species-rich grassland schemes	Hybrid	RBAPS- project database Schemes similar to those in Baden-Württemberg and Rheinland-Pfalz were available in the agri-environmental programming period for 2007-2013: - Niedersachsen & Bremen, - Rheinland-Pfalz, - Thüringen Bertke et al. 2008
DE, other federal states	2014	Species-rich grassland schemes	Hybrid	RBAPS- project database Schemes similar to those in Baden-Württemberg and Rheinland-Pfalz introduced to the agri-environmental programming period for 2014-2020 in: - Bayern, - Hessen, - Sachsen
DE Nordrhein-Westfalen	1993	Harrier nest protection in arable fields scheme	Hybrid	RBAPS- project database Run by association Arbeitsgemeinschaft Biologischer Umweltschutz im Kreis Soest e.V.
DE Bayern	1999	Harrier nest protection in arable fields scheme	Hybrid	RBAPS- project database Similar to Nordrhein-Westfalen scheme.
DE, various federal states	2007	German orchard schemes (~ 8 schemes)	Hybrid	RBAPS- project database

					Schemes with per-tree payments for traditional orchards under the AES are available in most German federal states. For example, in the period of 2007-2013: - Bayern: Streuobst Anbau (KULAP A45); - Brandenburg & Berlin: A5, Pflege von Streuobstwiesen‘; - Nordrhein-Westfalen: Vertragsnaturschutz Streuobstwiesenförderung (Paket 4301 und 4302; - Rheinland-Pfalz: PAULa Vertragsnaturschutz Streuobst.
DE Bremen	2005	Grassland bird protection scheme	Hybrid		RBAPS- project database Link to project website: projekte/naturschutz/artenschutz/wiesenvogelschutz/
DE Schleswig-Holstein	1997	Grassland bird protection scheme	Hybrid		
IE	2010	Burren Farming for Conservation Programme	Hybrid		RBAPS- project database RBAPS- site (includes a video). Burren Programme http://burrenprogramme.com/ BurrenLIFE - Farming for conservation in the Burren. LIFE04 NAT/IE/000125 National Parks and Wildlife Service. Burren Life Programme. https://www.npws.ie/research-projects/burren-life-programme
NL	2004	Meadow bird agreements	Hybrid	Collective payments	RBAPS- project database RBAPS-site (includes a video and conference presentation). de Lijster and Prager, 2012
NL	1993	Breeding meadow birds - per clutch trial scheme	Pure results-based	Discontinued	RBAPS- project database Musters et al., 2001; de Lijster and Prager, 2012; Verhulst et al., 2007; Kohler et al., 2007*
NL	2000	Meadow Bird Agreements scheme	Hybrid	Changed in 2004 and a new version	RBAPS- project database de Lijster and Prager, 2012; The Netherlands

				introduced for the period 2016-2020. Collective payments	Environmental Assessment Agency, 2007*
NL	2000	Species-rich grassland scheme	Hybrid	Changed in 2004 and a new version introduced for the period 2016-2020. Collective payments	RBAPS- project database As above Kohler et al., 2007*
ES Andalucía	2005	RAPCA (Red de Áreas Pasto Cortafuegos de Andalucía), pasture biodiversity	Hybrid		RBAPS- project database Ruiz-Mirazo et al., 2011
SE Sami Reindeer area	2000	Conservation performance payments (Lynx & Wolverine)	Pure results-based	Collective payments	RBAPS- project database RBAPS- site (includes a video) Zabel et al., 2014; Zabel and Roe, 2009; Zabel A and Holm-Müller, 2008
CH Solothurn	1995	Pastures in Canton Solothurn,	Hybrid		RBAPS- project database Albrecht et al., 2007*; Knop et al., 2006*; Kohler et al., 2007*; Schwab et al., 2002*
CH	2001	Species-rich grassland - (Öko-Qualitätsverordnung, ÖQV)	Hybrid		As above
CH	2001	Rebflächen mit natürlicher Artenvielfalt (ÖQV), Species-rich vineyards in Switzerland	Hybrid		As above

UK England, national park	1993–1996	Farm Conservation Scheme, species-rich hay meadows	Pure results-based		Buckingham et al., 1998*; Schwarz and Morkvenas, 2012*
		Pilots and prototype assessments			
ES, Navarra region	2016	Perennial crops of vineyards, olive groves and almond groves	Pure results-based		Project site: https://rbaps.eu/pilot-areas/navarra-spain/mosaic-farmed-habitats-navarra/ (Last accessed 23.03.2017)
IE, County Leitrim and Shannon Callows counties	2016	Species-rich Grassland, Marsh Fritillary butterfly Habitat, Wet Grassland suitable for Breeding Waders	Pure results-based	Results-based payment may be preceded by non-productive investments	Project site: https://rbaps.eu/pilot-areas/rbaps-measures-in-ireland/ (Last accessed 23.03.2017)
RO, Tarnava Mare and the Pogány Havas/Muntii Ciucului regions	2016	Hay meadows of high nature value	Pure results-based	Farmers are offered guidance on the type of management that is most likely to achieve the results	Project site: https://rbaps.eu/rbaps-projects-romania-uk/ (Last accessed 23.03.2017)
UK, England, Wensleydale and Norfolk/ Suffolk	2017	Species rich hay meadow, Habitat for breeding waders, Winter bird food, Pollen and nectar plants	Pure results-based		Introduced into four existing agri-environment scheme options. Report available at https://www.gov.uk/government/publications/results-based-agri-environment-payment-scheme-rbaps-pilot-study-in-england (Last accessed 23.03.2017)
DE	2002	Prototype, White Stork *(Ciconia ciconia)* nests	Pure results-based		Johst et al., 2002.
DE Northeim (Niedersachsen)	2003–2006	Prototype, arable weeds	Pure results-based	Auctioning	Bertke et al., 2005*; Ulber et al., 2010*; Ulber et al., 2011.

FI	2015	Prototype, species-rich fallows	Hybrid	Birge et al., 2017
SE	2013	Prototype, landscape		Hasund, 2013
UK England	2013	Ex ante evaluation		Schroeder et al., 2013

[1] If abbreviated, references are available in the Reference list of the main document or in the list below (marked with *). Sources in national languages in grey literature (e.g., reports and scheme documentation) are listed as Supplement Table A.2.

* Full references:

The Netherlands Environmental Assessment Agency (2007) Executive summary of the ecological evaluation of Nature Conservation Schemes run under the Stewardship Programme and the Dutch National Forest Service 2000-2006.

Kohler F, Verhulst J, Knop E, Herzog F and Kleijn D (2007) Indirect effects of grassland extensification schemes on pollinators in two contrasting European countries. Biol Conserv 135: 302–307

Albrecht M, Duelli P, Muller C, Kleijn D and Schmid B (2007) The Swiss agri-environment scheme enhances pollinator diversity and plant reproductive success in nearby intensively managed farmland. J Appl Ecol 44, 813– 822

Knop E, Kleijn D, Herzog F and Schmid B (2006) Effectiveness of the Swiss agri-environment scheme in promoting biodiversity. J Appl Ecol 43, 120–127

Kohler F, Verhulst J, Knop E, Herzog F and Kleijn D (2007) Indirect effects of grassland extensification schemes on pollinators in two contrasting European countries. Biol Conserv 135: 302–307

Schwab A, Dubois D, Fried P M and Edwards P J (2002) Estimating the biodiversity of hay meadows in north-eastern Switzerland on the basis of vegetation structure. Agric Ecosyst Environ 93, 197–209

Buckingham H, Chapman J and Newman R (1998) Meadows beyond the Millennium: The future for Hay Meadows in the Peak District National Park.

Schwarz G and Morkvenas Z (2012) Review of outcome based agri-environmental payments and guidelines for the practical implementation of a pilot scheme in Lithuania. Baltic Compass project.

Bertke, E., Gerowitt, B., Hespelt, S. K., Isselstein, J., Marggraf, R., Tute, C. (2005) An outcome-based payment scheme for the promotion of biodiversity in the cultural landscape. In Lillak, R, Viiralt, R, Linke, A, Geherman, V (eds), Grassland Science in Europe: Integrating Efficient Grassland Farming and Biodiversity, pp 36–39. European Grassland Federation, http://www.europeangrassland.org/fileadmin/media/EGF2005_GSE_vol10.pdf#page=53

Ulber, L, Klimek, S, Steinmann, H-H and Isselstein, J (2010) A market-based payment scheme for plant diversity in farming systems. Aspects of Applied Biology No 100 (Agri-environment schemes - what have they achieved and where do we go from here?), 319–326.

Appendix A.2. Grey literature sources in national languages for the existing and discontinued results-based payment schemes for biodiversity in agricultural environments in Europe, listed by country.

Country and scheme(s)	Sources in national languages
Austria Ergebnisorientierter Naturschutzplan (ENP) Semi-natural grazed habitats	AgrarMarkt Austria https://www.ama.at/getattachment/84609631-6a37-4596-afe9-f65572e7c50d/MEB_Oepul2015_Ergebnisorientierter_Naturschutzplan_3-0.pdf
France Pastoral management plan (HERBE_09) Semi-natural grazed habitats	Agreil, C., Barthel, S., Daneels, P., Greff, N., Guerin, G., Meignen, R., Mestelan, P. (2009). Étude pour l'accompagnement de mesures agro-environnementales territorialisées combinant l'engagement unitaire Herbe_09 « Gestion pastorale ». Propositions méthodologiques à destination des opérateurs pour l'élaboration du plan de gestion pastorale.
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